Freeze dryer

Freeze dryer freezes samples including aqueous solution or water at least below -40°C, reduces the pressure under water vapor pressure of the temperature and sublimates and dries ice.
Freeze dry for this is consist of a sample drying chamber for frozen (or self-frozen) samples, a vacuum pump for reduced pressure and a cold trap (or condenser) to capture vapor sublimated.
Freeze drying occurs at low temperature, so samples are not deteriorated well by heat. After drying, samples are resolvable well, so it is appropriate for the concentration of aqueous solution.
Original characteristics of samples such as taste, flavor, shape or substances are mostly remained after drying with this method.
Therefore, with freeze drying, samples which have unstable biological activities in moisture condition or aqueous solution can be preserved for a long time.
Recently, freeze drying is applied to the wide range from pharmaceutics, biology and food industry to petro-chemistry and semiconductor industry, and -120°C ~ -130°C freeze dryer is widely used for smooth drying of samples in accordance with freezing point of solvent to be diluted.

Considerations for choosing freeze dryer

The user should consider several details before choosing freeze dryer.

1. Decide the temperature of the capture section in accordance with samples to be dried or freezing point of solvent to be diluted.
2. Decide the capacity of the capture section considering the amount of samples to be tried once and the moisture content.
3. Decide the temperature range of the heat plate.
   Freeze dryer for production is designed to adjust the heat of sublimation when drying from -47°C to +70°C by circulation heating medium on the heat plate to increase productivity.
4. Recognizing samples' characteristics – whether samples after drying can be exposed to air temperature or air pressure.
5. Choose drying type considering the next processing stage after drying samples.
   Prepare appropriate accessories such as bulk tray, flask or vial, mini tray or acrylic drying chamber for drying type.
   This prevents budget waste caused by purchasing unnecessary accessories and helps to go to the next stage.
6. Consider the budget
   To decide the purpose of use and method is the wisest and important to purchase accessories with the best performance available within the budget. Also, it prevents to purchase unnecessary devices or accessories or inappropriate equipment for the purpose in advance.

Application

Freeze dryer can be used in all areas in which samples including aqueous solution and water are dried at low temperature to minimize the deterioration of the samples by heat.
In biotechnology field, it is applied to study or produce protein, microorganism or strain etc. Also, freeze dried powder is easy to dissolve in water, so it is frequently used in food and pharmaceutical industry, and it is necessary for injections, blood relative processing, vaccine relative research or production progress.
Recently, it is applied to petro-chemistry, semiconductor or macromolecule field.
Especially, FDT freeze dryer of OPERON can be applied as for optimizing production or process development.

※Specifications of freeze dryer may be partly different from standards.

Freeze dryer-FDT-(Bulk tray type)-for production

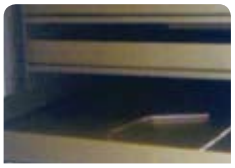
Bulk Tray type

[FDT-12012]

[FDT-8620]

Configuration

a. Dry section / b. Freezing section /
c. Vacuum section / d. Control section /
e. Options



Shelf & Tray

Trap Coil

Vacuum pump

Features and advantages

- Square-shaped drying chamber can reduce the installment area about over 30% by maximizing the effective area for drying compared to other company's circular chamber with the same capacity.
- -156°C cryogenic cooling system registered to the international patent and Operon Auto Cascade System, the original technology for -203°C cryogenic cooling system are combined to realize quick freezing and quick defrosting functions.
- Experiment data like sample temperature or degree of vacuum is stored on SD Card already equipped and is easily transferred to the user's PC to analyze.
- The user can choose automatic or manual function for the dry program, and when choosing automatic function, the user can program by choosing the temperature of the heat plate or drying time.
- Selected vacuum pump contains automatic Gas Ballasting function, so it releases gas which fills the pump to get better degree of vacuum.
- Embedded vacuum release valve automatically operates to prevent a back flow of contaminated oil and gas in the pump when blackout, cold trap temperature rise or pump operation stop by mishandling.
- It is equipped with automatic protection function for the vacuum pump which makes the vacuum pump operates automatically when the temperature of the cold trap decreases below the certain temperature which the user sets regarding the freezing point of samples and the vacuum pump automatically turns out when the temperature increases over the setting temperature.
- Transparent acryl chamber with a thickness of 40mm is safe for the user to see the drying process.
- The automatic defrosting device defrosts quickly after drying.

Options

1. Vacuum pump (range): 400LPM ~ 1600LPM
2. Option for changing the temperature of the heat plate (for FDT)
3. Option for additional shelves
4. Chemical trap
5. Oil mist trap
6. Activated carbon
7. Option for changing materials (SUS316)
8. Option for changing the temperature of the cold trap
9. CIP (Automatic cleaning device)
10. SIP (Automatic sterilization device)
11. Stoppering device

Freeze dryer-FDT-(Bulk tray type)-for production

Bulk Tray type

[FDT-12032]

[FDT-8650]

Freeze dryer (Bulk tray type) – Production scale

Model		Bulk Tray Type											
		FDT-86100	FDT-55100	FDT-12050	FDT-8650	FDT-12032	FDT-8632	FDT-12020	FDT-8620	FDT-12012	FDT-8612	FDT-12006	FDT-8606
Main Body	Cold Trap Temp	-86°C	-55°C	-120°C	-86°C	-120°C	-86°C	-120°C	-86°C	-120°C	-86°C	-120°C	-86°C
	Capacity	100L		50L		32L		20L		12L		6L	
	Shelf Temp	-47°C~+70°C(Standard) , -115°C~+70°C(Option)											
	Dimension	W1600 x D2500 x H2100		W1554 x D1311 x H2179		W1554 x D1311 x H2071		W1554 x D1311 x H2071		W1404 x D1211 x H1932		W1000 x D1000 x H1850	
	Chamber Size	(W505 x D890 x H690) x 2EA		W505 x D890 x H690		W505 x D890 x H550		W505 x D890 x H550		W370 x D600 x H430		W330 x D550 x H330	
	Trap Size	W505 x D890 x H690		Φ420 x L750		Φ350 x L750		Φ345 x L480		Φ315 x L450		Φ315 x L300	
	Shelf/Tray	20EA/18EA		8EA/7EA		6EA/5EA		5EA/4EA		5EA/4EA		4EA/3EA	
		W470 x D740 x H40		W470 x D740 x H40		W470 x D740 x H40		W470 x D740 x H40		W320 x D450 x H40		W280 x D280 x H40	
	Programmable Controller	10" LCD touch screen programmable controller with USB, Auto/ Manual start-up controller, Display cold trap temp. & vacuum pressure(2000mTorr~0mTorr)											
	Sample Sensor	3port of display sensor & 1printer sensor											
	Pump Protection System	Built-in(Automatic pump start & stop control system for vacuum pump)											
	Defrost	Auto											
	Electric	220V/440V 3ph		220V/440V 3ph				220V/440V 3ph		220V/440V 3ph	220V/1ph	220V/440V 3ph	220V/1ph
	Weight	1000kg / 900kg		780kg / 750kg / 730kg / 700kg				680kg	650kg	580kg	550kg	480kg	450kg

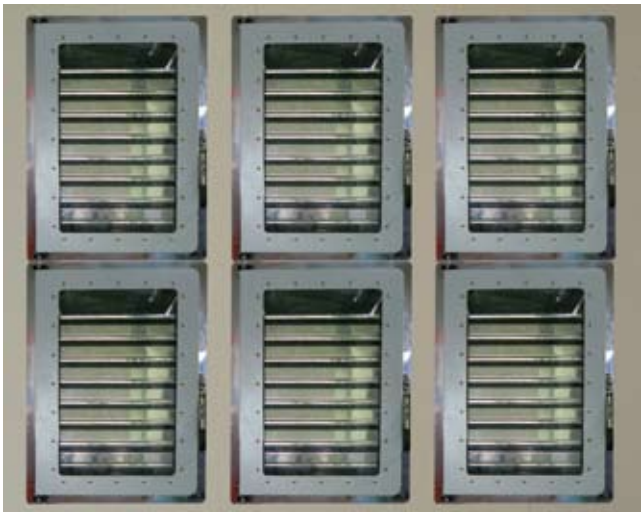
Freeze dryer-FDT-Freeze dryer for production
(drying chamber / cooling unit combination & built-in type)

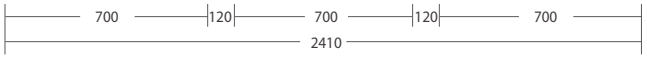
Bulk Tray type

Clean Room

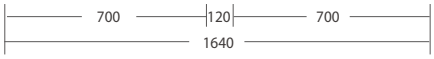
Clean Room – Freeze dryer for production appropriate for installment condition

[300kg]





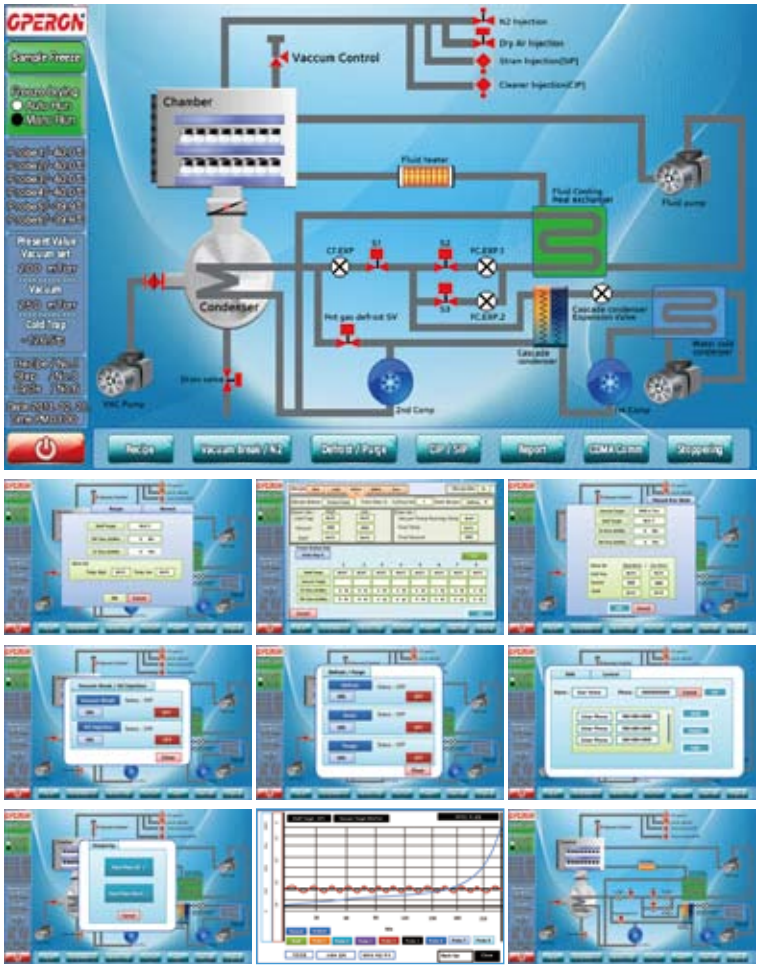
[200kg]



[100kg]

Controller

LCD touch screen programmable controller



(It may be different from the actual image)

- 10" Color TFT LCD, 26thousand COLOR, 800 x 480 (Basic)
- ARM Cortex-A8, 1GHz
- SDRAM 256MB / NAND FLASH 256MB
- Resistive touch panel embedded
- SD card embedded

- 15" Color TFT LCD, 26thousand COLOR, 1024 x 768 (Option)
- ARM Cortex-A8, 1GHz
- SDRAM 256MB / NAND FLASH 256MB
- Resistive touch panel embedded
- SD card embedded

- Recipe provide: 99Program / 50Step /50Cycle
- Provide the convenient user-oriented interface with recipe backup and call function
- Sample monitoring sensor: 6 Probe (choose one among Thermocouple K, J and RTD)
- Provide automatic / manual operating mode
- UI (User Interface) presentation of real-time temperature, vacuum monitoring and operating control in the form of animation
- Realization of delicately controlled operating with the application of control algorithm based on PID
- Provide TS (reaching time of setting temperature) and TM (maintenance time of setting temperature)
- Provide various sample drying methods with vacuum control
- Provide relative matters with CIP, SIP
- Provide centralized control such as various control valves nitrogen, steam, Dry Air, Isolation Valve, Defrost, Drain, Purge (If choosing CIP or SIP)
- Provide freeze drying method like vial by stoppering control
- Control with mobile is available for various alarms and operating state with the application of U-system (Ubiquitous System). (Option)
- Check whether the freeze dryer itself is abnormal with diagnostics
- Provide Korean and English version
- Block the access of outsiders or persons not permitted with security function which needs login (ID/Password)
- Monitor hourly accessors, operating record, alarm list etc by searching the report on control
- Simple backup of recipes, various UI settings and settings relative to controlled operating with the application of parameter backup/download

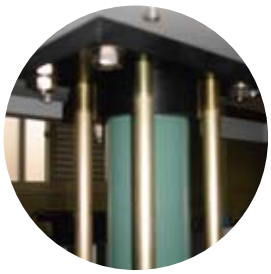
Freeze dryer-FDTS-(Stoppering type)

Stoppering type

[FDTS-12012]

Stoppering Program

Hydraulic Stoppering System (Bottom to top)



Freeze dryer(Bulk tray - Stoppering type) - Production scale

Model		Stoppering type									
		FDTS-12050	FDTS-8650	FDTS-12032	FDTS-8632	FDTS-12020	FDTS-8620	FDTS-12012	FDTS-8612	FDTS-12006	FDTS-8606
Main Body	Cold Trap Temp	-120°C	-86°C	-120°C	-86°C	-120°C	-86°C	-120°C	-86°C	-120°C	-86°C
	Capacity	50L		32L		20L		12L		6L	
	Shelf Temp	-47°C~+70°C(Basic) , -115°C~+70°C(Option)									
	Trap Size	Φ420 x L750		Φ350 x L750		Φ345 x L480		Φ315 x L450		Φ315 x L300	
	No. of tray / Shelf size	7EA		5EA		4EA		4EA		3EA	
		W660 x D660 x H22		W660 x D660 x H22		W500 x D500 x H22		W460 x D460 x H22		W460 x D460 x H22	
	Stoppering system	Hydraulic bottom to top stoppering system									
	Programmable Controller	10" LCD touch screen programmable controller with USB, Auto/ Manual start-up controller, Display cold trap temp. & vacuum pressure(2000mTorr~0mTorr)									
	Sample Sensor	3port of display sensor & 1printer sensor									
	Pump Protection System	Built-in(Automatic pump start & stop control system for vacuum pump)									
	Defrost	Auto									
	Electric	220V/440V 3ph				220V/440V 3ph		220V/440V 3ph	220V/1ph	220V/440V 3ph	220V/1ph
	Weight	780kg / 750kg / 730kg / 700kg				680kg	650kg	580kg	550kg	480kg	450kg

Freeze dryer-FDB

Bench Top Model

Product features and specifications

- Choosing the wide temperature range from -86°C to -55°C available
- Compact freeze dryer for the laboratory table
- Installing manifold type or drying chamber available
- Strong structure frame and impact resistant powder coating finishing
- Filter cover for easy cleaning
- Bench-top type structure
- Temperature measuring sensor: platinum PT 100Ω(Class A 0.15 grade)
- Equipped with the valve for auto vacuum release to prevent a back flow of contaminated oil or gas

[FDB-5503]

[FDB-5502]

Control System

- Microprocessor control system
- One touch type automatic operation of freezing & vacuum function
- Buttons for choosing automatic & manual function
- Functions for automatic operating start and automatic setting temperature for stop to prevent the vacuum pump

[Optional items]

Tube holder

T-type manifold

Drying chamber+D-Type manfold+Mini tray

Pump table

Freeze dryer(Bench top type) - Lab scale

Model		FDB-5503	FDB-5502	FDB-7002	FDB-8602
Main Body	Cold Trap Temp	-55°C	-55°C	-70°C	-86°C
	Capacity(total)	3L ~ 4.5L	2L ~ 3L	2L ~ 3L	2L ~ 3L
	Dimension	W480 x D570 x H480	W345 x D500 x H540		
	Trap Size	Φ315 x L180	Φ155 x 195		
	Controller	Microprocessor controlled LED digital display 0.1°C increment & vacuum display 2000mTorr~0mTorr			
	Pump Protecteion System	Built-in			
	Defrost	Manual defrost			
	Electric	Capacity necessary for installment AC220V 1ph (50/60Hz)			
	Weight	50Kg	40kg	45kg	50kg

Options

1. Vacuum pump (100LPM ~ 200LPM)
2. Drying chamber
3. Mini tray or three stage shelf
4. T-TYPE manifold
5. D-TYPE manifold
6. Vacuum valve + Cap + Adaptor
7. Flask (1000ml ~ 150ml)
8. Vacuum oil
9. Vacuum grease
10. Tube holder
11. Pump table
12. Stainless rack + Box
13. Oil mist trap
14. Chemical trap

Freeze dryer-FDU

Upright type

Product features and specifications

- Choosing the wide capacity range from 24L to 3L available
- Choosing the wide temperature range from -90°C to -55°C available
- Powerful freezing performance to start drying within 15minutes ~ 30minutes
- Compact and movable upright type freeze dryer
- Installing manifold type or drying chamber available
- Strong structure frame and impact resistant powder coating finishing
- Filter cover for easy cleaning
- Upright type structure
- Temperature measuring sensor: platinum PT 100Ω(Class A 0.15 grade)
- Equipped with the valve for auto vacuum release to prevent a back flow of contaminated oil or gas

Control System

- Microprocessor control system
- One touch type automatic operation of freezing & vacuum function
- Buttons for choosing automatic & manual function
- Functions for automatic operating start and automatic setting temperature for stop to prevent the vacuum pump

[Optional Rotor when ordering the model equipped with the concentrator]

Freeze dryer(Upright type) - Lab scale

Model		Upright-type							
		FDU-8624	FDU-7024	FDU-8612	FDU-7012	FDU-8606	FDU-7006	FDU-8603	FDU-7003
Main Body	Cold Trap Temp	-90°C	-70°C	-90°C	-70°C	-90°C	-70°C	-90°C	-70°C
	Capacity(total)	24L ~ 28L		12L ~ 15L		6L ~ 8L		3L ~ 4.5L	
	Dimension	W850 x D846 x H1037		W850 x D796 x H987		W500 x D646 x H976			
	Trap Size	Φ315 x L680		Φ 315 x L380		Φ 315 x L300		Φ 315 x L180	
	Controller	Auto/Manual start-up controller, Display cold trap,Temperature & vacuum pressure(2000mTorr ~ 0mTorr), printer set							
	Pump Protecteion System	(Automatic vacuum pump start & Stop controller system)							
	Defrost	Auto				Manual			
	Electric	Capacity necessary for installment AC220V 1ph (50/60Hz)							
	Weight	180kg		155kg		115kg		110kg	

Options

1. Vacuum pump (100LPM ~ 200LPM)
2. Drying chamber
3. Mini tray or three stage shelf
4. T-TYPE manifold
5. D-TYPE manifold
6. Vacuum valve + Cap + Adaptor
7. Flask (1000ml ~ 150ml)
8. Vacuum oil
9. Vacuum grease
10. Oil mist trap
11. Chemical trap
12. Rotor for vacuum concentration (1.5ml X 210/ 1.5ml X 72/ 15ml X 12/ 50ml X 6/ swing rotor)
    (Concentrator equipped model is available for the large upper plate with 12L capacity)

Freeze dryer-FDCF

Chemical-free Upright type

Product Introduction : Only Operon, -120°C Chemical free freeze dryer for organic solvents

Product features and specifications

-156°C cryogenic cooling system registered to the international patent and Operon Auto Cascade System, the original technology for -203°C cryogenic cooling system are combined to realize quick freezing and quick defrosting functions.

Technical Data sheet

Features and advantages

- Chemical free freeze dryer is -120°C ~ -135°C cold trap with powerful freezing power, and it can capture organic solvents whose freezing point is -115°C ~ -95°C like ethanol, methanol, acetone, hexane or Iso-Octane.
- In case of samples whose freezing point is below -100°C, an expensive cryogenic freezer or liquid nitrogen is needed for pre-freezing. That is expensive and inconvenient way, and especially, liquid nitrogen is risky to use and has a possibility to contaminate samples. Also, samples are not frozen well in the general -86°C freezer, or while moving frozen samples to the drying chamber, samples are melted, so the examination is likely to fail. Chemical free freeze dryer of OPERON uses stainless five stage mini tray for self-freezing (pre-freezer embedded) below -120°C, and it is appropriate for the quick, convenient and efficient experiment.

Freezing Section

- Freezing system: Duality cooling system applied with Auto Cascade Systems of OPERON registered to the international patent
- Concentrator capacity: 1.5HP x 2 Set
- Refrigerant: CFC-free eco-friendly mixed refrigerant
- Refrigerant oil: Polyester oil
- Cold trap size: Ø345 x L380mm
- Cold trap capacity: 12L
- Cold trap material: Stainless steel SUS-304(Teflon coating)
- Material for Cold trap lid: Transparent acryl
- Defrosting: Automatic defrosting

Control Section

- Presentation Section: STN-2Tone(Blue/White) LCD Display(128x64 Dot, 60x32mm) / 6Point LED Presentation of state)
- Entering Section: 6Point Touch Key.
- Entering the temperature sensor: 1ch (Extension to 6ch for monitoring – option)
- Entering the vacuum sensor: 1ch
- Range of degree of vacuum (degradability): 2000~0mTorr /1mTorr
- Sending monitoring data: Send temperature or monitoring data to PC or Konics data recorder, thermal printer.
- SMS sending function: Send SMS to the registered phone number when alarming

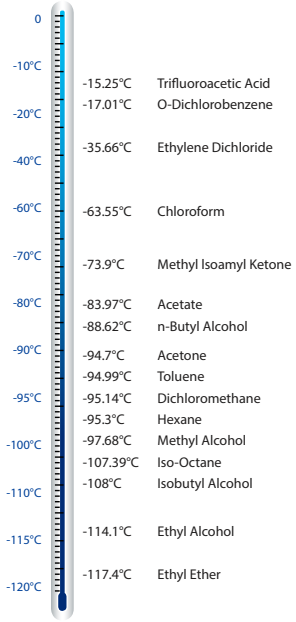
Vacuum Section

- Vacuum sensor (Varian)
- Valve for auto vacuum release

Drying section options and other options

- Vacuum pump: 100LPM ~ 1600LPM
- Manifold (T-type : 24P ~ 8P) / D-type : 12P ~ 8P)
- Five stage mini tray
- Flask (150ml ~ 1000ml)
- Vacuum valve + Cap + Adaptor
- Option for additional shelves
- Device for heating the heat plate (For FDCF, FDU, FDB, FDS)
- Chemical trap
- Oil mist trap
- Activated Carbon
- Torch
- Stoppering device
- Used as vacuum concentration
- Used as Shell freezer
- Drying chamber (transparent acryl, stainless square chamber)
- Three stage shelf

Freezing Points



Application

Chemical free freeze dryer is used to dry directly diluted solvents without other preprocessing in the samples such as ethanol, methanol, acetone, hexane or Iso-Octane whose freezing point is -115°C ~ -95°C. Especially, chemical free freeze dryer of OPERON is the world first below -120°C dryer for chemicals. This product is used by users who experiences frequent breakdown of the vacuum pump and experiment failures while using -85°C ~ -50°C freeze dryer from other companies.

Freeze dryer(Chemical free type) - Lab scale

Model		Chemical Free		
		FDCF-12012	FDCF-12006	FDCF-12003
Main Body	Cold Trap Temp	-120°C	-120°C	-120°C
	Capacity(total)	12L ~ 15L	6L ~ 8L	3L ~ 4.5L
	Dimension	W850 x D796 x H987		W500 x D646 x H976
	Trap Size	Φ 345 x L380	Φ 315 x L300	Φ 315 x L180
	Controller	Auto/Manual start-up controller, Display cold trap, Temperature & vacuum pressure(2000mTorr ~ 0mTorr), printer set		
	Pump Protecteion System	(Automatic vacuum pump start & Stop controller system)		
	Defrost	Auto		Manual
	Electric	220V/1Ph(50/60Hz)		
	Weight	210kg	190kg	180kg

Freeze dryer-FDUT (Compact Dryer)

Combination type/all-in-one type

Cooled & Heated Compact type)

When purchasing freeze dryer for production, FDUT combination type (COMBI) model is appropriate if the amount of samples to be dried once is below 6L, if the budget is limited or if the user has the cooling equipment like the cold trap or freeze dryer for experiment.

FDUT products are embedded with heated & cooled shelf in the dryer chamber like freeze dryer for production, and dry program is used with automatic/ manual settings, and it is connected with the cold trap or freeze dryer which the user already has with vacuum line to capture vapor or moisture from the dryer chamber.

The user can choose the dry chamber capacity from 3L to 6L, and all-in-one FDUT which is embedded with the dry chamber and the cold trap is from 2 to 4L.

Features and advantages

- Square-shaped dry chamber can reduce the installment area about over 30% by maximizing the effective area for drying more compared to other company's circular chamber with the same capacity.
- -156°C cryogenic cooling system registered to the international patent and Operon Auto Cascade System, the original technology for -203°C cryogenic cooling system are combined to realize quick freezing and quick defrosting functions.
- The user can choose automatic or manual function for the dry program, and when choosing automatic function, the user can program by choosing the temperature of the heat place or drying time.

Combination type(FDUT-8606)

All-in-one type(FDUT-6002)

All-in-one type : Freeze dryer (Cooled & Heated – All-in-one type) – Pilot scale

Specification	FDUT-6002	FDUT-8602	FDUT-12002
Dimension(Overall)	W500 x D646 x H1468		
Chamber size	W300 x D360 x H352		
Shelf temp.	-47°C~+40°C		
Shelf Quantity	Standard-(W240 x D240) x 3EA		
Door	Tempered Glass door		
Controller(Drying Chamber)	LCD programmable & Manual drying controller		
Medium	Silicone oil(Dow corning 10cst)		
Circulation	Circulation pump(March pump)		
Cold trap temp	-60°C	-86°C	-120°C
Cold trap capacity(total)	2L ~ 4L		
Controller(Cold trap)	Microprocessor controlled LED digital 0.1°C increment display Cold trap./Vacuum pressure(2000mTorr~0mTorr)/Printer set/Auto&manual selection)		
Defrost	Manual		

Combination type : Freeze dryer (Cooled & Heated - Combination type) - Pilot scale

Part	Specification	FDUT-12012	FDUT-12006	FDUT-12003	FDUT-8612	FDUT-7012	FDUT-8606	FDUT-7006	FDUT-8603	FDUT-7003
Cooled & Heated Drying chamber	Dimension	(Overall) W500 x D646 x H1468 / (chamber) W300 x D360 x H352								
	Shelf Temp	-47°C~+40°C								
	Shelf Quantity	Standard-(W240 x D240) x 3EA								
	Door	Tempered Glass Door								
	Controller	Manual & Programmable drying controller(LCD)								
	Medium	Silicon oil(Dow Corning 10cst)								
	Circulation	Circulation Pump(March Pump)								
	Recorder	Square type Temperature recorder (Archived or Real time print)								
Cold Trap	Dimension	W850 x D800 x H1000					W850 x D650 x H980			
	Temp	-120°C			-90°C	-70°C	-90°C	-70°C	-90°C	-70°C
	Capacity(total)	12L ~ 15L	6L ~ 8L	3L ~ 4.5L	12L ~ 15L	12L ~ 15L	6L ~ 8L	6L ~ 8L	3L ~ 4.5L	3L ~ 4.5L
	Controller	Microprocessor controlled LED digital 0.1°C increment display Cold trap./Vacuum pressure(2000mTorr~0mTorr)/Printer set/Auto&manual selection)								
	Defrost	Auto(Hot gas by pass-12L이상) & Manual defrost-12L이하								
Chamber option	Stoppering system	Top to bottom								
Weight		350kg	340kg	330kg	320kg	310kg	295 kg	290kg	285 kg	280kg

Options RVacuum pump (range): 100LPM ~ 1600LPM / Option for the temperature change of the heat plate (for FDT) / Option for the additional shelves / Chemical trap / Oil mist strap / Stoppering system

Freeze dryer-FDS

Stoppering freeze Dryer

Stoppering type freeze dryer of OPERON is appropriate for samples which should be sealed into the Vial bottle in a vacuum after drying.
It can be simple to use for the small amount of samples less than 10ml x 140pieces

[Stoppering Device]

Features and advantages

- It has a wide range of options for various capacities from 24L to 3L and cold trap temperature from -90℃ to -55℃.
- It is compatible with any freeze dryer models for experiment of OPERON, and if the user already has OPERON products, it can be used interchangeably with an additional stoppering device.
- The lift device to lift and lower the stoppering device is used conveniently to put or take out samples. (only for 12L – option)
- After drying, it sealed the lid of glass bottle in a vacuum to prevent samples perfectly from moisture and external environment.
- Selected vacuum pump contains automatic Gas Ballasting function, so it releases gas which fills the pump to get better degree of vacuum.
- Embedded vacuum release valve automatically operates to prevent a back flow of contaminated oil and gas in the pump when blackout, cold trap temperature rise or pump operation stop by mishandling.
- It is equipped with automatic protection function for the vacuum pump which makes the vacuum pump operates automatically when the temperature of the cold trap decreases below the certain temperature which the user sets regarding the freezing point of samples and the vacuum pump automatically turns out when the temperature increases over the setting temperature.
- Transparent acryl chamber is safe for the user to see the drying process (option).

Freeze dryer(Stoppering type) - Lab scale

Model			FDS-12012	FDS-8612	FDS-7012	FDS-12006	FDS-8606	FDS-7006	FDS-12003	FDS-8603	FDS-7003	FDS-5503
Main Body	Cold Trap Temp		-120℃	-90℃	-70℃	-120℃	-90℃	-70℃	-120℃	-90℃	-70℃	-55℃
	Cold Trap Capacity(total)		12L ~ 15L			6L ~ 8L			3L ~ 4.5L			
	Dimension (mm)	Drying Chamber	Φ 300 x L330 (Transparent acrylic drying chamber -option)									
		Cold Trap	W850 x D796 x H987			W500 x D646 x H976			W480 x D570 x H480			
	Cold Trap		Φ345 x L380			Φ315 x L300			Φ315 x L180			
	Controller		Auto/Manual start-up controller, Display cold trap temperature & vacuum pressure(2000mTorr~0mTorr) printer set									
	Stoppering System		Clear acrylic lid+3shelves+stoppering device (높이:600)									
	Pump Protection System		(Automatic vacuum pump start & Stop control system)									
	Defrost		Auto				Manual					
	Electric		220V/1ph, 60hz/50hz									
	Weight		230kg	175kg	175 kg	210kg	135 kg	135 kg	200kg	130kg	130kg	70 kg

Options

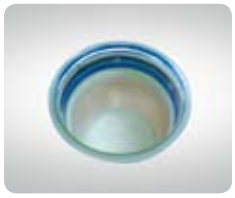
1. Vacuum pump (range): 100LPM ~ 1600LPM
2. Manifold (D-type) 8Port ~ 12Port
3. Flask
4. Vacuum valve + Cap + Adaptor set
5. Option for additional shelves
6. Device for heating the heat plate (for FDCF, FDU, FDB, FDS)
7. Chemical trap
8. Oil mist trap
9. Activated carbon
10. TORCH
11. Used as vacuum concentrator (combination type)
12. Shell freezer (combination type)
13. Drying chamber

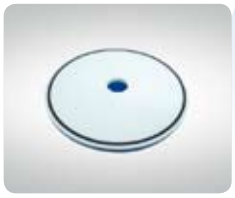
Freeze dryer-FDG

Glass type freeze dryer (for acid)

It is highly recommended to use FDG (for acid) of OPERON. If samples or solvents to be diluted in samples contain sulfuric acid, hydrochloric acid or acetic acid.
The drying chamber and the cold trap of FDG is made with borosilicate glass.
Therefore, if the proper experiment or production is difficult because of corrosion of stainless or Teflon coated materials, the model for acid of OPERON is appropriate.


Glass drying chamber


Glass cold trap


Teflon Disc

[FDG-120]

Features and advantages

- The drying chamber and the cold trap of freeze dryer for acid is made with borosilicate glass, so it is appropriate to dry samples which contain toxic substances like sulfuric acid, hydrochloric acid or acetic acid.
- -156°C cryogenic cooling system registered to the international patent and Operon Auto Cascade System, the original technology for -203°C cryogenic cooling system are combined to realize quick freezing and quick defrosting functions.
- Selected vacuum pump contains automatic Gas Ballasting function, so it releases gas which fills the pump to get better degree of vacuum.
- Embedded vacuum release valve automatically operates to prevent a back flow of contaminated oil and gas in the pump when blackout, cold trap temperature rise or pump operation stop by mishandling.
- It is equipped with automatic protection function for the vacuum pump which makes the vacuum pump operates automatically when the temperature of the cold trap decreases below the certain temperature which the user sets regarding the freezing point of samples and the vacuum pump automatically turns out when the temperature increases over the setting temperature.
- Transparent borosilicate glass chamber is safe for the user to see the drying process (embedded).
- After drying, defrost water is easily separated to discharge into the special container.

Freeze dryer (Glass type - borosilicate type for acid) - Lab scale / Industrial scale

Model			FDG-120	FDG-105	FDG-90
Main Body	Cold Trap Temp		-120°C	-105°C	-90°C
	Cold Trap Capacity(total)		12L ~ 15L		
	Dimension(mm)	Drying Chamber	Φ300 x L230		
		Cold Trap	Φ300 x L250		
		Overall	W850 x D800 x H1410(Included drying chamber)		
	Materials	Drying Chamber	Borosilicate Glass A3.3		
		Cold Trap	Borosilicate Glass A3.3		
		External	Cold rolled steel with powder coated		
		Insulation	High density urethane foam		
	Controller		Auto/Manual start-up controller, Display cold trap temperature & vacuum pressure(2000mTorr~0mTorr), printer set		
	Pump Protection System		(Automatic vacuum pump start & Stop control system)		
	Defrost		Manual defrost		
	Electric		220V/1Ph, 60Hz/50Hz		
	Weight		230kg		

Options Vacuum pump (range): 100LPM ~ 1600LPM / Chemical trap / Oil mist trap / Activated carbon / Drain device

Freeze dryer-MPS

Multi purpose system

[MPS-5502]

Features and advantages

- The size and weight of the device is very compact, and it can be used as both cold trap & freeze dryer and freeze dryer & mini concentrator, and it can be connected with vacuum oven or gel dryer to dry small amount of samples.
- Selected vacuum pump contains automatic Gas Ballasting function, so it releases gas which fills the pump to get better degree of vacuum.
- Embedded vacuum release valve automatically operates to prevent a back flow of contaminated oil and gas in the pump when blackout, cold trap temperature rise or pump operation stop by mishandling.
- It is equipped with automatic protection function for the vacuum pump which makes the vacuum pump operates automatically when the temperature of the cold trap decreases below the certain temperature which the user sets regarding the freezing point of samples and the vacuum pump automatically turns out when the temperature increases over the setting temperature.

MPS-55 (Multi Purpose System)

Dimension(WxDxH)	W345 x D474 x H540	**Chamber**	Stainless steel
Lowest temperature	-55°C	**Drain**	Silicon hose
Cold trap lid	Clear acrylic lid	**Vacuum connector**	Id-10mm/od-19mm
Trap chamber volume(total)	2 ~ 3 L	**Defrost**	Manual
Optional manifold	6port with valve	**Display**	LED/0.1°C increment
Weight	about 29kg (optional manifold -4kg)		

MPS-70 (Multi Purpose System)

Dimension(WxDxH)	W345 x D474 x H540	**Chamber**	Stainless steel
Lowest temperature	-55°C	**Drain**	Silicon hose
Cold trap lid	Clear acrylic lid	**Vacuum connector**	Id-10mm/od-19mm
Trap chamber volume(total)	2 ~ 3 L	**Defrost**	Manual
Optional manifold	6port with valve	**Display**	LED/0.1°C increment
Weight	about 29kg (optional manifold -4kg)		

MPS-86 (Multi Purpose System)

Dimension(WxDxH)	W345 x D474 x H540	**Chamber**	Stainless steel
Lowest temperature	-55°C	**Drain**	Silicon hose
Cold trap lid	Clear acrylic lid	**Vacuum connector**	Id-10mm/od-19mm
Trap chamber volume(total)	2 ~ 3 L	**Defrost**	Manual
Optional manifold	6port with valve	**Display**	LED/0.1°C increment
Weight	about 29kg (optional manifold -4kg)		

MSVQ-20 (Mini Speed Vacuum Concentrator)

Dimension(WxDxH)	W213 x D335 x H223	**Chamber**	SUS with Teflon coating
Rotor	1.5ml x 20hole(Anodizing)	**Lid**	Clear acrylic lid
Speed control	0 - 2000rpm	**Centrifuge**	Max.2000 rpm
Heat control	Amb. +5°c ~ +65°c	**Vacuum connector**	id-10mm/od-19mm
Vacuum Gauge	0 ~ 76cmHg	**Rotor safety**	Speed control (0 = off)

Accessories for freeze dryer

T manifold (24port ~ 6port)

Drying Chamber + three stage shelf (heating type/ non-heating type)

Drying Chamber + five stage mini tray (heating type/ non-heating type)

Drying Chamber + three stage shelf (heating type/ non-heating type) + D-Type Manifold (6.8.12 Port)

Rotor used as the concentrator

Stainless square chamber (heating type/ non-heating type)

Five stage mini tray (heating type/ non-heating type)

Drying Chamber + five stage mini tray (heating type/ non-heating type) + D-Type Manifold (6.8.12 Port)

Chemical trap

Oil mist trap (small/large)

Adaptor & Cap, Flask (150ml~1000ml)

Vacuum valve / Vacuum grease

Thermal printer

Oil rotary vacuum pump ($1.5x10^{-3}$Torr) 100LPM ~1600LPM

Shell freezer + flask rolling kit

Stoppering device

Pump table

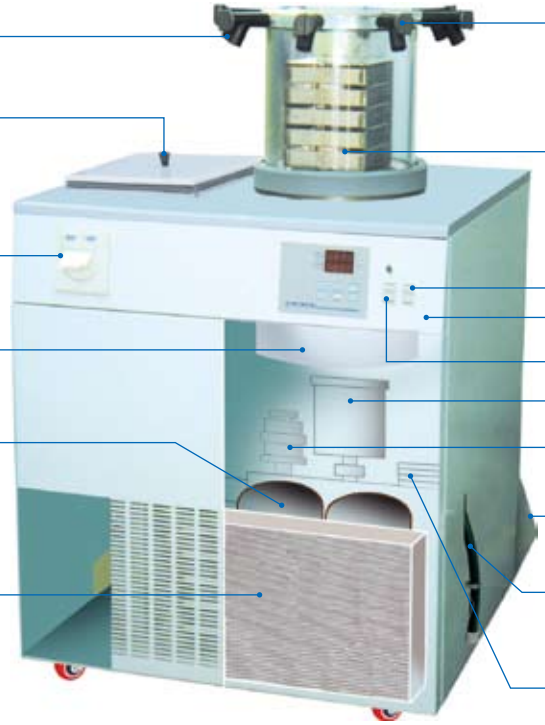
Square chamber (large) – non-heating

Tube holder

D manifold + vacuum valve

F/D Description

Controller 1 (LCD controller : option)



Basic

Controller

START/STOP	The first pump starts to operate 2 minutes after the refri lamp turns on.
MODE	Temperature setting for operation the vacuum pump 'Auto' or 'Manual' setting for the vacuum pump, printer setting
←↑	Push ↑ key to choose mode (Auto / Manual). Push ← ↑ key to set the temperature and vacuum pump.
Vacuum	If the cold trap reaches the setting temperature, push 'VACUUM' key to operate the vacuum pump (Manual mode)
Enter	Push 'ENTER' key to settle setting temperature.
LED digital presentation of the cold trap temperature and vacuum pressure (2000 ~ 0 mTorr)	

Option

- Presentation Section: STN-2Tone(Blue/White) LCD Display
  (128x64 Dot, 60x32mm)
  6Point LED Presentation of state)
- Entering Section: 6Point Touch Key.
- Entering the temperature sensor: 1ch (Extension to 6ch for monitoring – option)
- Entering the vacuum sensor: 1ch
- Range of the temperature (degradability): -200~+100 / 0.1°C
- Range of degree of vacuum (degradability): 2000~0mTorr /1mTorr
- Sending monitoring data: Send temperature or monitoring data to PC or data recorder, Thermal printer.
- Provide U-System: Mobile central control (maximum twelve cold traps)
- Vacuum alarm: When the cold trap is out of control by leak, the alarm is sent to the user.
- Vacuum pump protection function: Equipped with overload limit function for prevention of vacuum pump operation at atmospheric pressure by leak or breakdown
- Power display: Presentation of current power status value and sending alarm in case of low or high tension

(It may be different from the actual image)